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EDUCATIONAL MONOGRAPHS

PUBLISHED BY THE

NEW YORK COLLEGE FOR THE TRAINING OF TEACHERS

NICHOLAS MURRAY BUTLER, EDITOR

VOL. III. No. 5.

{ Entered at the Post Office at New York
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} WHOLE NO. 17.

HAND-CRAFT

BY

JAMES CRICHTON-BROWNE, M.D., LL.D., F.R.S.,

*Lord Chancellor's Visitor, Vice-President of the Royal
Institution of Great Britain, and Member of the
Academy of Medicine of New York.*

SEPTEMBER, 1890

NEW YORK: 9 UNIVERSITY PLACE

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PREFATORY NOTE.

At the request of several educationists the Editor takes great pleasure in printing in the EDUCATIONAL MONOGRAPHS, with the consent and approval of the author, the following paper on Handcraft which first appeared in the *National Review* for August, 1888. It is believed that Dr. Crichton-Browne's exposition of the physiological argument for Manual Training will be a valuable aid in the contemporary discussion of this educational problem. It is in some respects unfortunate that the author had not studied the effect of introducing constructive work in wood and iron into the schools of Sweden, France and the United States before reaching his conclusions as to that aspect of the question.

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Handcraft.

Whoever takes a comprehensive survey of England in these days, and notes the teeming masses in her cities and towns, the prolific multitudes scattered in her hamlets and cottages, and the increasing inadequacy of her fields, even when brought to their highest state of cultivation, to support their human burden, must soon realize the vital significance of the question, "Wherewithal shall we buy bread that these may eat?" And the obvious answer to that question, that the means to provide sustenance for this great company must be procured by exchanging for food the products of their industry, is scarcely calculated to allay the anxiety that it has conjured up, for we are told from many quarters that our industrial supremacy is on the wane, and that foreign nations are rapidly supplanting us in those markets where we have been wont to exchange for corn the fruits of our skill and labor. After the Paris Exhibition of 1867, the cry was first raised as to continental and American progress in engineering and manufactures, and since that time we have had to listen to an ever swelling chorus of voices warning us that we are losing our leading position in the race of races, and must redouble our efforts if we are to hold our own. Now it is, as far as we are concerned, unhappily too true, that several foreign countries have developed their manufactures in a remarkable way in recent times, and deprived us of some of the advantages which we formerly enjoyed in competing with them; but it is, I venture to say, not true that there has been, as we are often assured, any decadence in the ingenuity, intelligence, skill or perseverance of our working population, or that they have

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failed, during the last twenty years, to advance as rapidly as any population in the world, in all the constructive and decorative arts.

The gloom and chilliness of that protracted depression of trade which has hung round our planet like a belt of Saturn for several years, but which may be dissipated any morning by a brisk trade wind—springing up no man knows where—the gloom and chilliness of this depression predisposes us to pessimistic views, and to give credence to statements which in brighter moments we would brush impatiently aside. And thus it is, I think, that even sagacious heads are shaken over statements like that of Mr. Oscar Browning, that we are every year losing ground in the race of industry to the better-trained foreigner, owing to our deplorable education, which prevents us at present from looking any foreigner in the face without a blush; or like that of Mr. Wilson, Head Master of Clifton College, that he came back from a visit to the continent with a feeling of humiliation, not unmixed with alarm, when he contrasted our condition and prospects with those of our industrial rivals; or like that of Mr. Felkin, that England is being robbed in detail of her industrial supremacy; or like that of Mr. Mundella, that everyone must know that what we have to contend with is the lack of technical instruction for our working classes.

The difficulties and dangers that beset our industrial position are serious enough, and the need of an improved system of technical education amongst us is indisputable; but our difficulties are not to be overcome by misconceiving their source, nor ought our wants to be supplied on an exaggerated estimate of the benefits that are to accrue from the improvements we desire. And that it is a misconception to suppose that our industrial embarrassments have arisen from any deterioration or diminished rate of progress in the abilities or energies of our working classes, or that they can be relieved by technical education

alone, however valuable that may be, I hope to be able to show. A rich and varied storehouse of facts bearing on the point at issue is to be found in the Report of the Royal Commission on Technical Instruction, and anyone who will take the trouble to ransack that storehouse through and through, as I have done, will, I think, arrive at the comforting conclusion that we have no occasion to feel humiliated or to go about Europe blushing when the skill of our artizans and fabricators is in question. The Commissioners, who were appointed specially to compare the industrial capabilities of our own people with those of other countries, may be assumed to have directed their attention more particularly to those industries in which comparison was most easy, and in which England is most closely pressed; and it is, therefore, highly reassuring to find that in almost every branch of industry the palm is unhesitatingly awarded to this country. Their visits to establishments on the Continent, their conversations with the most eminent authorities, and with work-people in every department of manufacture which they investigated, and the inquiries carried on for them by deputies, have all combined to convince the Commissioners that, taking the arts of construction and the staple manufactures as a whole, our people "still maintain their position at the head of the industrial world."

Let me quote the verdicts of the Commissioners, or of those whom they consulted, upon a few of the industries which they passed under review. "In the ironworks of Westphalia," they say, "it was admitted that England may fairly claim the pre-eminence of the world." "In cotton-spinning and weaving" in Belgium, they remark, "English machinery and models are adopted everywhere, and English competition is the despair of every mill-owner." In the engineering works at Chemnitz, they report, "the superiority of English over other tools was willingly acknowledged, while we satisfied ourselves that

the workmen there do not get through the same quantity of work that English workmen accomplish." In calico-printing, they conclude, "England still remains undoubted master." With reference to the textile manufactures of Saxony, they say, "Both yarns and pieces are generally in a better state after leaving the spinner and weaver in England than in Germany and France, while in the spinning of lustre, demi-lustre, and damask yarns, the manufacturers admitted that Bradford stands unrivalled." As regards the dyeing of mixed goods with cotton warp in the woollen industries of France, they intimate, "the French merchants are willing to admit the superiority of English dyers." In respect of the silk industries of Creffeld, they explain that "the manufacturers there are much less afraid of the future competition of France and Switzerland than of England. In power-loom weaving in particular, and in improvements in machinery, one English manufacturer has outstripped all rivals, and at the present time the honor of possessing the largest and probably the most successful silk factory in the world, belongs to a Yorkshire manufacturer." At the cotton-mill of MM. Henrich Kunz the Commissioners were assured by Mr. Hans Wunderly, whose judgment is entitled to the greatest weight, that the English are at the head of all the workmen he has ever seen, and he is familiar with those of France, Switzerland, Germany, and Italy. "For practical knowledge of their work and mechanical genius" they are, Mr. Wunderly declared, "better without technical education than continental workmen are with it, while for physical endurance and all-round capacity they know no rivals."

These extracts, taken at random from the second part of the Report, might have been multiplied indefinitely, but they are perhaps sufficient to establish that there is overwhelming evidence that the right hands of our workmen have not lost their cunning. One rises from the perusal

of the Report without blushing or humiliation, but with a feeling of just pride that the inhabitants of this little island should still so manifestly excel in so many and such diverse pursuits. Each country on the Continent of Europe has some one particular star of industry, by which it is distinguished, but this country has a whole galaxy to boast of. And, indeed, our own experience in little matters leads us to the same conclusion as the Commissioners on Technical Education, for if we want a really good watch, a trustworthy and lasting timekeeper, we ask for one of English make, the Ecole Horlogerie of Besançon notwithstanding; and if we want a pair of gloves that will fit and hold together, we look for a big D on the buttons, and prefer that as a guarantee to any French or Saxony trade-mark.

But while the Report of the Technical Commissioners affords not a tittle of evidence that there has been in England any decline or fall in the dexterity, ingenuity, or productiveness of our work-people, of any class, it supplies abundant confirmation of the statement, often repeated and now painfully brought home to many of us, that there has been an enormous development of manufacturing power on the Continent in various branches of industry in the last quarter of a century, and that our markets are being encroached on and taken from us by rivals, who, if they do not equal us in skill yet surpass us in the cheapness of the commodities which they produce, and in their persistent energy in forcing these upon the markets. Everywhere on the Continent we hear of the establishment of new works and mills, or of the extension of old ones, and of endeavors to undersell England and oust her from markets of which she formerly held exclusive possession. Vast strides have been made by France Germany, and Switzerland in the exportation of manufactured goods of many kinds, which England at one time supplied to all who wanted them, and the utmost

activity prevails in these countries in pushing their trade and diminishing the cost of their productions.

Now if we inquire how it is that England with unreduced skill and energy and command of capital is suffering so severely in the competition that is going on, we come upon several explanations. Many of what ought to be our greediest markets are closed to us by foreign tariffs, while foreign operatives are content to work for far longer hours, and for far lower wages, than our own. Then foreign manufactures are not hampered to the same degree with English ones, by restrictive Factory Acts and regulations as to the employment of children, nor are they embarrassed as much by the dictation of trades unions, nor do they on the whole suffer as much from time-breaking through drink. Railway rates, again, are sometimes in favor of the foreign manufacturer as against his English opponent, while in mountainous districts on the Continent cheap power is obtained, in a way denied to England, by the abundant water-supply utilized for motive purposes by turbines. But of all the causes which have contributed to the success of continental countries in their industrial attacks on England the most potent has perhaps been the unstinted introduction into them of English machinery, and of trained English instructors. When steam-engines were first introduced, and for years afterwards, England was fortunately situated in having abundant supplies of coal and iron, a clever set of handcraftsmen, and ample capital, advantages not shared by the rest of the world. The natural result was that the multiplied production of the machine, combined with the excellence and increased cheapness of the product, enabled her to compete everywhere with all comers. Hence the very large profits made in the early days of machinery, when the foundation of the prosperity of the principal northern manufacturing towns and firms was laid. "The nation most happily placed for taking advantage of

steam naturally reaped a great harvest, but as the use of steam superseding human labor has spread, and as machinery for the utilization of steam has been acquired by continental countries, the primary and exceptional advantages of England have shrunk." The fact is, that England has been long busily engaged in distributing over the Continent weapons with which she is now herself assailed; and go where you will, you now find the most perfect creations of English hands doing their best to steal the bread from English mouths. Nearly all the cotton-spinning machinery in France, Belgium, and the Rhine provinces, has been imported from England. The wool-combing establishments of France are furnished with splendid machinery and engines from England, and so are the woollen factories of Belgium and Italy. In textile factories everywhere looms from Bradford and Keighley are found at work, and in hosiery factories also English machinery abounds. In engineering and steel and iron works in Belgium, Switzerland, and Germany, English tools and machinery are extensively employed. In every corner of Europe where industry has raised its head, the mechanical slaves of England are toiling for foreign masters, and not only so, but English men as well as machines are found enlisted in the campaign against the mother country. Several essentially English industries have been transplanted to the Continent by colonies of English operatives, who have been induced to take up their abode there, and English managers, foremen, superintendents, engineers, and mechanics have been chiefly instrumental in developing, and are largely employed in directing many kinds of manufacture in every part of Europe. But here we come upon indications of the effects of the higher scientific and technical education which is now being zealously carried on in many Continental States, for the evidence is clear that English managers and foremen are not now as frequently employed on the

continent as they formerly were. The theoretical instruction in the scientific principles applicable to trade and the practical training afforded in polytechnic schools, insure now an ample supply of persons competent to become heads of departments, capable of anticipating results, of calculating beforehand the quantity and quality of materials required, of originating new methods, and of meeting contingencies. English foremen and superintendents are therefore not in such request as they once were. The opinion of the well-informed seems to be all but unanimous that technical training is of the first importance to those who are to take a leading and controlling part in works, and especially in works connected with chemical industries, but opinion seems to be almost equally unanimous that technical instruction may very well stop here, and that it is not necessary or desirable for the lower strata of the toiling masses. Leaving out of view at present the beneficial influence of various subjects, scientific and practical, included under technical education as recreative and elevating pursuits, it is of interest to note that all over Europe those who know most of large industrial concerns put a strict limit to what technical education can accomplish, and do not expect from it any improvement in the skill or fertility of the general body of workpeople. That the marked superiority of England in manufactures hitherto has been in no way attributable to technical education, will be obvious when it is remembered that the great complaint against us is that we have neglected this, in comparison with our neighbors, and that the remarkable advances in manufacturing prosperity achieved by our neighbors cannot justly be ascribed to it, becomes clear when it is demonstrated that this may almost invariably be traced in each particular case to some other cause. In many instances we find the Technical Commissioners themselves guarding against exaggerated notions as to what this special education has done or can

do. "In France," they observe, "as in other countries, we did not receive any evidence that technical schools have been of advantage to spinning or weaving." "If the hosiery and glove manufactures of Chemnitz," they remark, "are taking a strong position, this appears to be due to other conditions and not to the influence of technical education." "In the silk industries of Rhenish Prussia," they add, "it was represented that theoretical knowledge would be a drawback to the workers." One of the chief engineers of Saxony discredited technical schools to the Commissioners, because they subordinate the practical to the theoretical, and Dr. Siemens told them that there are more polytechnic schools in Germany than are necessary.

And here the question may properly be asked, What are the conditions, then, which have favored the industrial superiority which this country has so long enjoyed? If technical education is of value only to the pioneers, what is it that has made the great army of workers capable of following their lead? What is it, and this is really the supreme question for us, that in the absence of technical education has enabled the English nation to assume a commanding position in most of the fields of industry which it has entered, and that must receive attention if that commanding position is to be maintained? We have already in part answered this question when advertizing to the advantages of England's geographical position, and of her mineral wealth, but other factors have contributed in no mean degree to her industrial supremacy, and to these I would direct attention. They consist in (1) the characteristics of the race, (2) the good health of the people, (3) their inherited skill, (4) the early training of their hands.

The characteristics of the Anglo-Saxon race, which in its westward migrations gave it victory over feebler tribes, have availed it in its industrial conflicts not less than in

its territorial wars, and given it possession of many of the most fruitful portions of the earth's surface, thus enabling it to secure for itself that ample supply of food which is essential to good physical development and sound health. And good physical development and sound health have again nourished the spirit of enterprise, enabled the Anglo-Saxon race to extend its dominion, and played a far larger part than is often appreciated in the establishment of that commercial and industrial supremacy which it has heretofore enjoyed. It is not insular vanity, but scientific truth, to say that the English people excel all other European peoples at this day in bodily development and health. In height, weight, and chest girth any large number of Englishmen will give a higher average than an equal number of Frenchmen, Germans, or Belgians. Army returns relating to conscripts and recruits, vital statistics dealing with the mortality of large towns, and the results of investigations as to the relative prevalence of certain forms of disease, put it beyond cavil that the standard of health is higher with us than in other countries, and that we are more exempt than they from physical deformities and defects. Far, indeed, are we in any of these matters from being what we ought to be, but still it behooves us to recognize the position we occupy, and to look to it jealously that we lose no point in that competition in health and strength which, after all, lies at the very foundation of industrial prosperity. The Technical Commissioner, although looking with unprofessional eyes, did not fail to notice the inferiority of continental operatives to English ones in bodily stamina and working power. "Swiss workers," they report, "are short and thick-set in comparison with English ones." "The factory girls of Saxony," they declare, "are less comely than those of Nottingham." "The wool-workers of Alsace," they say, "are not equal in strength to those of Yorkshire and Lancashire," and German engineers,

although intelligent and healthy, "cannot get through the same amount of work with English ones."

Now this physical superiority and better health of our working classes is surely a most precious endowment, deserving of anxious conservation. On the lowest ground, and apart from that higher pleasure in existence which it connotes, it is the very marrow of our industrial system. As long as we remain a little taller than our industrial antagonists, as long as we outweigh them in the balance, score more on the spirometer than they, and outstrip them in athletic sports, we can afford to look calmly on temporary checks to industry in times of readjustment, to pursue without apprehension our destined path, and to keep our heads cool even on the subject of technical education. But there is need, and grave need, at this juncture, of emphasizing the truth that corporeal health and vigor lie at the root of all true success in national as in individual life; for there is some risk that in our alarm at the losses we have sustained and with which we are threatened, in the industrial campaign, and at the manœuvres of those who strive with us, we may be led to adopt measures calculated to sacrifice a cardinal to a subsidiary condition of victory. There are preachers abroad, able and eloquent preachers too, who, being deeply impressed by our diminished exports and contracting markets and by the educational activity of the Continent, would persuade us that our only hope for the future lies in a high pressure and enforced system of education, elementary and technical, which, if carried out as they advise, would, by sapping the nervous energy of our people and reducing their health standard, do infinitely more mischief in our industrial future than any attainments which it might secure could do good.

If, bearing in mind that the pre-eminence of this country has been achieved under no very advanced system of what is commonly called education, but by virtue, in great

measure, of natural advantages and of the strength, health, spirit, and endurance of our men and women, we proceed to inquire how this strength, health, spirit, and endurance, originally race characteristics, have been fostered and sustained, we meet immediately one circumstance or set of circumstances which, amongst many, merits special consideration in this connection, and that is the restrictions which have, for some time, been imposed amongst us on the labor of the weak and immature. These restrictions, as has been admitted, somewhat handicap our manufacturers in the meantime; but no medical man who examines their effects, and contrasts the accounts transmitted to us of the dwarfed, bandy-legged, and sickly factory hands of the past with the actual condition of our mill-workers of to-day, can doubt that they have been beneficent in their operations, and must in the long run give us the advantage over manufacturing countries in which they are not adopted. Even as it is, our operatives hold their own and produce as much per head as those who, on the Continent, toil for far longer hours. And in the future, it may be safely predicted, they will, if they have their health maintained at a high level and are protected against exhaustion and over-strain, altogether distance those who go on making inordinate drafts on their constitutional resources. But in order that they may do this the benefits of these restrictions must be secured to them, and all attempts resisted to introduce, under a disguise, what would practically amount to an extension of the hours of labor. We are told with admiration of some employers on the Continent who have provided for their hands evening classes, in which subjects having a direct bearing on their daily work are taught, and attendance on which is compulsory up to certain ages, and it is not obscurely hinted that technical education might be partly carried on here by some such method. Now, yielding to no one in my appreciation of technical and science

teaching in their proper place, I would venture to urge, that it would be disastrous to resort to such a veiled scheme of industrial home-lessons or keeping in, and that what the bulk of our unskilled or slightly skilled operatives, who form the broad base of our pyramid of industry, require in their evening hours, is not a renewal or continuation of the work of the day, but an entire change, healthy exercise, restorative rest, exhilarating recreation, and complete liberty to do with their leisure what they please. Let there be science and technical and literary classes for those who have the will and power to push on—the born sons of genius or the tortured victims of ambition—or for those who find refreshment in intellectual pursuits; but for the dense masses of our work-people, who need only a small modicum of specialized skill in their daily task, quite other pastimes are desirable in order that degeneracy may be avoided. Their lives are tedious and monotonous, and they want variety, and would certainly not do their work any better for being lectured on applied science. For them, nothing but injury to health, and mental dyspepsia or discontentment, could accrue from any curtailment of their off-time, and indeed the tendency should be rather to extend than to curtail this. The division of labor, which is still steadily going on, almost involves this, for it is impossible for anyone, without detriment, to keep at some minute bit of handicraft for the same time that might be devoted to a varied and interesting occupation, without fatigue. And the segregation of labor in factories means the same thing, for the drain on attention is much heavier in the case of work carried on in a crowd than in that of work done in privacy; and the growing nervousness of the age, which elementary education must, however wisely regulated, more or less aggravate (for all education tends to nervousness), also suggests a lightening rather than an augmentation of our labor burdens, for the more sentient

a human being becomes, the less capable is he of bearing long drawn out drudgery. The load that was borne with dogged determination by coarsely organized nerves becomes excruciating to these that are finely strung, and must be often shifted, or else destructive anodynes will be had recourse to. The rapid multiplication of music-halls in our towns of late years, the portentous diffusion of betting, and the ever-increasing railway-traveling of our working classes are, I conceive, signs of the craving for change and excitement which monotonous occupation engenders, and which is not to be appeased by technical education, or banished by grandmotherly meddling on the part of employers. Unless the signs of the times are strangely misread, what our operatives in this country require are good wages, ample facilities for instruction and amusement, good music, accessible art, and absolute freedom to regulate their own affairs. They would surely resent the dispensation—described to us in glowing terms—under which many Continental operatives are content to live, a dispensation under which they are housed, and gardened, and tutored, and doctored, and co-operative-stored, and superannuated by the firm. It must be confessed that a dismal sense of inexorable routine and individual extinction is created by the pretty picture of their well-ordered lives. There comes a not unwarrantable apprehension that imbecility might result in a few generations from such wholesale and pertinacious dry-nursing, under which crowds of men are grown, fed, and tended with an eye to their productiveness, just as flocks of Aylesbury ducks are with an eye to their plumpness; and a suspicion steals into the mind that the tatters and hardships of the gipsy's tent are in some lights preferable to such clock-work comfort and prim propriety. One is almost tempted to travesty the Laureate and exclaim:

Were it not better not to be
Than live so full of industry.

There is no doubt something attractive in the outside survey of a huge well-oiled, smoothly-working social machine, but it is to be hoped that we do not include in our dreams of industrial development the conversion of the whole country into an immense factory, spotlessly white-washed, well ventilated, with a smokeless chimney, and surrounded by garden allotments, schools, museums, laboratories, laundries, cottage hospitals, and neat cemeteries over which "well-groomed weeping willows" wave conventional woe.

The third factor in the industrial superiority of this country, second only in importance to physical development and health, is the inherited skill of our work-people—that special quickness and aptitude of hand and eye which are drawn from a long line of industrially trained ancestors. Anyone with half an eye must have seen how gestures and habits of movement and expression pass on from sire to son even when imitation was impossible, and must agree with George Eliot when she exclaims—

I need a record deeper than the skin!
What, shall the trick of nostrils and of lips
Descend through generations, and the soul
That moves within our frame like God in worlds,
Convulsing, urging, melting, withering,
Imprint no records, leave no documents,
Of her great history?

Deep imprints, elaborate documents inscribed with the history of many a silent and forgotten soul, exist in each of us. All students of handwriting know how certain styles of penmanship run in families and remain unaltered under the most diverse methods of instruction, and all students of heredity will be prepared to admit that not only may the children's teeth be set on edge because their fathers have eaten sour grapes, but that their fingers may be gifted with nimbleness because their fathers' brows have known the sweat of labor. There is one thing that cannot be manufactured to order, and that is the genius

of a people. It is not by the leaves of a summer, multitudinous though they be, but by the immemorial foliage of bygone years that the trunks of the forest have been built up; and it is not by the exertions of any one generation, but by slow increments of growth through centuries, that English brain and muscle have reached that special development which is the substratum of our manufacturing ability. It is certainly not in one generation that foreigners, with all the advantages of technical education, but with less handy progenitors, can acquire the manual dexterity which English people possess, and of which different varieties exist in different districts of the country, in which different kinds of industries, involving different kinds of movements, are carried on. The spinners of Oldham are said to be born with a twist in their fingers and thumbs, and in the button-mills of Birmingham I was assured by experienced persons. that children brought in from agricultural districts are slower in picking up the manipulations required in that trade, and clumsier in performing them, than the children of Birmingham button-workers themselves. In a large number of industries in which English workmen excel, it is acknowledged that an inherited predisposition has had something to do with their excellence, and wherever, on the Continent, any particular industry is conducted with peculiar skill, it is pointed out that a congenital adaptation to it exists. Thus, as regards the hand-loom silk-weavers of Lyons, the Technical Commissioners say that their skill is simply marvelous, families having been for generations distinguished for dexterity and delicacy in manipulations. "From father to son," they remark, "the loom has been handed down, and the weavers meet together and talk of their work until technical knowledge has become natural to them, and skill has been raised to a high degree of excellence." Of course machines, like Melchisedek, have neither father nor mother, and are innocent of hereditary

tendencies ; but wherever human beings are engaged in production, the fruits of their labor will, in quantity or quality, bear traces, like the cadence of their voice and accents of their speech, of the lineage from which they have sprung and of the locality in which they have been bred. The spider spreads its web, the silkworm spins its cocoon, and the upholsterer bee hangs its cell with the crimson damask of the rose, without any technical education, and inherited skill must count for something in the useful arts.

But inherited skill, the third factor in our industrial supremacy, will be of small avail to human beings if it is not called into play by timely exercise, and this brings us to the fourth, and last-named factor—early training of the hand. In the affairs of every organ in the body, it is now recognized, there is a tide which, taken at the flood, leads on to fortune, but which, if neglected at this critical time, leaves the organ more or less hopelessly stranded, and, in the case of the hand, that tide is in flood early in life. Writing masters attest that children who are left to a certain age without instruction can never afterwards be taught to write with grace and fluency, and a glance at any biographical dictionary will convince that almost all those who have arrived at eminence in pictorial or plastic art have felt the impulse to manual expression in early life, and have exercised themselves in it while still very young. Giotto was discovered by Cimabue, sketching on a stone one of the sheep which he was shepherding when only ten years old. Gainsborough gave proof of marked talent for landscape painting when scarcely fourteen. Canova modelled exquisitely in butter when thirteen years old. Turner exhibited in the Royal Academy at the age of fifteen. Sir Edwin Landseer gained the prize of the Society of Arts when he was thirteen. George Moreland had pictures accepted by the Academy when not yet ten. Thorwaldsen had made a reputation

as a carver of the figure-heads of ships when thirteen, and Wilkie drew spirited portraits of his schoolfellows when only seven. And so in every employment in which the hand is used, it might be shown that those who have become most proficient have used the hand early, and that, as an instrument, the hand is always awkward and unwieldy that has been left untrained in youth.

But this great principle, that the hand that is to be really a hand and not a bunch of thumbs must be trained early, rests now no longer on empirical observations, but has a physiological explanation beneath it. It has now been established by the researches of Hughlings-Jackson, Ferrier, and others, that the brain is not as it was at one time supposed, a single organ acting as a whole, but a congeries of organs capable of more or less independent action. The brain, it has been shown, may be roughly divided into a sensory and a motor area, and an area that is not demonstrably either sensory or motor, the last-named lying in front, and being probably concerned in the higher mental processes, the second, lying behind and below, being the receptacle of the impressions poured in by the senses, and the third, lying in the middle, being the fountain of all muscular movements in which will, intention, or memory are involved. And it has been further shown that this motor area, lying in the middle of the brain, is made up of a number of distinct centres, presiding over groups of muscles, and excitation of which is followed by definite movements. This is clearly exhibited in Ferrier's experiments. The animal, let us say a monkey, deeply asleep from chloroform, lies on the table before the Professor. The top of the skull is rapidly removed, the membranes are divided, and the living but slumbrous brain is exposed to view. The Professor then touching certain points on the surface of the brain, with the electrodes connected with a galvanic battery, produces with unerring precision whatever movements may be

desired. I will cause the monkey, he says, to close its hand; he touches a particular convolution, when instantly the fist is clenched. I will cause it, he goes on, to move its tail; he touches another point, and the caudal appendage (if it happens to have one) is wagged vigorously. I will cause it, he continues, to protrude its tongue; he touches another point, and out comes the unruly member. And so on through movements of the lip and nostril, leg and foot, hand and arm, trunk and head, mouth and eyes. In every instance the definite movement predicted follows on the galvanic stimulation of the appropriate centre, and the same movement invariably follows the stimulation of the same centre. To the uninitiated observer, the whole process looks like magic or an ingenious trick, and one layman who witnessed it was with difficulty persuaded that the monkey was not made of gutta-percha and fitted with springs. Not more certainly does the piano respond by certain notes to the depression of certain keys than does the brain answer by definite movements to the electric touch of certain defined centres.

Now these motor centres, which have been experimentally demonstrated in the brains of animals, have been proved by the demonstrations of that arch-vivisection disease—who is always performing the cruelest experiments on human beings, and without anaesthetics—to exist in the human brain in exactly the same order that they do in the brains of animals, so that we are scientifically entitled to affirm that a large area in the middle of the human brain is made up of motor centres, and that amongst these motor centres there is a series or group which presides over the movements of the hand and arm. But in speaking of this middle region of the brains and the centres included in it as motor, it must be mentioned that the word motor is used in a special sense. These centres are not motor simply in the sense of sending forth motor impulses in response to excitation from without—the re-

flex centres in the spinal cord can do that—but motor in the sense of being the springs of movements dictated by the will, or necessary for the expression of thought or emotion, or the gratification of desire, and in the sense of being the repository of the chronicles of all the knowledge that our muscular operations have put us in possession of. Ideal movements form a no less important element in our intellectual acquisitions than ideally revived sensations which we have experienced, and the muscles not only obey the commands of volition, but vastly increase our information and furnish us with indispensable instruments of thought. The crudest analysis of our ideas at once reveals to us that we have very few that are of purely sensory composition, and that very few objects are known to us by their sensory characters alone. If we conjure up before us the idea of an orange, we have a revival in memory not merely of the brilliant patch of color that affected the retina, and of the fragrance that titillated the olfactory nerves, but of the circular sweep of the eyeballs caused by the movements of the muscles in traveling round the circumference of the figure. If we recall in memory some bygone conversation, or a passage from some favorite author, we revive not merely the sounds of the words or the vision of the printed symbols representing them, but the actual movements of the muscles of the chest, larynx, tongue, and lips that were necessary for their articulation. Brain motor centres are incessantly taking an indispensable share in our mental life, and mind would be as impossible without them as would the circulation of the blood without one ventricle of the heart; and besides this, they are constantly animating and controlling our muscular apparatus in all its intelligent applications. It is plain, then, that the highest possible functional activity of these centres is a thing to be aimed at with a view to general mental power, as well as with a view to muscular expertness; and as the hand centres hold a

prominent place amongst the motor centres, and are in relation with an organ which, in prehension, in touch, and in a thousand different combinations of movement, adds enormously to our intellectual resources, besides enabling us to give almost unlimited expression to our thoughts and sentiments, it is plain that the highest possible functional activity of these hand centres is of paramount consequence, not less to mental grasp than to industrial success. And that this highest functional activity of the hand centres is only to be reached through the exercise of the hand, and the early exercise of the hand, I shall next endeavor to show.

Motor centres in the brain, although capable, in a way, of spontaneous and independent action, do not, as a rule, act singly, but in combined and blended action with each other and with sensory centres, and in order that centre may thus co-operate with centre, pathways of communication must be opened between them. The little nerve cells that form the active part of each centre—the hidden arcana of the mental forces—must put forth buds and branches, or arms to entwine, or join hands with branches or arms from the cells of other centres, and innumerable cross-roads, loops and circuits must be opened up and worn smooth by traffic, in order that a brain potential may become a brain actual. A brain that is to be serviceable must be used and well used, and what is true of a brain is true of all its parts. A brain centre that is to be serviceable must be used and well used; and so it follows that the hand centres, if they are to be serviceable, must be used and well used. If a brain or centre is not used at all it undergoes degeneration, if it is imperfectly used it becomes weak and sluggish, if it is excessively used it becomes irritable and unstable. And the just use of every brain centre necessarily implies the just use of the bodily organs with which it is in connection. It is impossible to use a brain dissevered from a

body, a visual centre cut off from the eye, a motor centre cut off from its tributary muscles. It is impossible to establish communication between centre and centre, unless the parts subtending these centres are used. A muscle, the nerve of which has been divided so that it can no longer receive messages from its centre, undergoes fatty degeneration, and becomes permanently useless, and a centre that is separated from its peripheral sphere undergoes degeneration and becomes useless also. Gudden, a Swiss physiologist, has shown that if the eye of a young pigeon be enucleated, the visual centre in the brain will be found shortly afterwards to have wasted away; and it is a common observation that in persons who have been long bed-ridden by chronic disease, and debarred from all muscular exercise, the whole motor area of the brain is, after death, more or less atrophied and water-logged. It is unquestionably essential to the welfare of all motor centres, and especially of the large and complicated motor centres of the hand, that the parts with which they are immediately connected should be used in an active and varied manner.

But I must go a little farther than this, and maintain that use, to be truly useful to brain centres, must be resorted to, at the proper time, and that exercise has an even more significant relation to the growth and development of centres than to the maintenance of their healthy activity.

The several centres of the brain do not expand and blossom all at once. They evolve gradually and in succession, and in every brain there are at one and the same time zones of budding spring, of luxuriant summer, and of harvest, opulent or meagre as the case may be. In the first months of life the human brain is smooth on its surface, as the brains of many animals are permanently (the rabbit for instance); and it is during infancy, childhood, and youth, that the convolutions, or foldings on its surface, which so largely increase its area, make their

appearance, while at the same time the cells in the grey matter, which at birth are round, put forth buds and filaments, and become caudate, stellate, and branched. The brain may go on increasing in size up till twenty-five years of age, but it is during infancy and childhood that it grows most rapidly; and then it is that the convolutions are rounded off, and the centres evolved, not all contemporaneously, but in definite order and at different rates; then it is that the cells in each centre are plastic, mobile, and prolific, and may be stimulated to extend their connections. I need scarcely remark that the infant uses its leg muscles in walking long before its articulatory muscles in speech, the explanation of this being that the motor centres of the leg, in the brain, are in advance in their development of the motor centres of the tongue and lips. We now know that each centre has its own nascent or growth period, which is sometimes very short, as it must be in the centre in which the movements of sucking are co-ordinated, and sometimes very long, as in those in which are co-ordinated the movements of the hand, from its first feeble grasp, up to its consummate achievements in shaping and making. But whether the nascent period be long or short, it is of signal importance to the whole future of the centre, that it should be taken advantage of while it lasts, and that the organs related to the centre should be duly exercised during its continuance. If the nascent period is permitted to slip past unimproved, no subsequent labor or assiduity will compensate for the loss thus sustained.

As regards the sensory centres there is not much danger of their remaining unexercised; for unless you shut a boy up in a dark and silent chamber, or blindfold him and stuff his ears with cotton-wool, you can scarcely prevent him from using his eyes and ears, while the probability is that his palate, if he be left to himself, will suffer rather from over-indulgence than from defective stimula-

tion. But as regards the motor centres the case is very different, for we can restrain the use of the muscles as a whole or in groups, and deprive them of that healthy activity which is needful for their own development and for the well-balanced growth of the brain. We can pin boys down on benches, we can restrain them for restlessness, we can coerce them to walk sedately, we can withhold their hands from exploration and mischief, and their whole bodies from rollicking activity ; and in doing so we are modifying the development of their brains. In two cases since the definition of the centres by Ferrier was accomplished, post mortem examinations have been made on the bodies of adult men who had each lost a leg in early infancy, and in the brains of both of them the centre for the lost leg was found somewhat stunted and undeveloped. On the other hand, post mortem examinations have been performed on the bodies of several men who had had a leg amputated after they had grown up, and had lived for many years thereafter, and in their brains the leg-centres have always been found of fully average size ; from which it may be deduced that a brain motor centre, cheated of appropriate exercise at its nascent or growth period, does not develop properly, but that the same centre if deprived of appropriate exercise after it is once fully developed, does not necessarily dwindle and decay. In the latter case, having, during its development, formed communications with many other centres, it is not altogether thrown out of the circle of mental life when the limb, which informs it, and by which it is informed, is removed, but may still continue to take part in ideation, and to maintain its nutrition by adequate functional activity.

Now if the argument that the development of motor centres in the brain hinges in a great degree on the movements and exercises of youth has been followed and accepted, it will be readily understood how important the

nature of the part played by early exercise of the hand is in evoking inherited skill, and in creating the industrial capabilities of a nation. It will be readily perceived how essential it is still to insist on early exercises of the hand, if our industrial superiority is to be maintained. The nascent or development period of the hand centres has not yet been accurately measured off; it probably extends from the first year to the end of adolescence; but there can be no doubt that its most active epoch is from the fourth to the fifteenth year, after which these centres become comparatively fixed and stubborn. Hence it can be understood that boys and girls whose hands have been left altogether untrained up to the fifteenth year are practically incapable of high manual efficiency ever afterwards. And hence we can comprehend how, by keeping the children of our working-classes without hand-training, and in school up to that age, poring over books, by cramming them with decimals and geography, while their hands hang flaccid, and their digits grow clumsy and stiff, by withholding them from timely exercise in handicraft, we should be doing our best to abolish the skill of our next generation of workers. It has been urged lately by men of light and leading—amongst others by Mr. Wilson, head-master of Clifton College—that the age of compulsory elementary education should be prolonged by a year or two, but it is earnestly to be trusted, that very careful inquiries will be instituted before any step of that sort is sanctioned. To me it seems not unlikely that such an extension of verbal at the expense of manual education would defeat the very object which those recommending it hold in view, and tend ultimately to banish manual dexterity and expertness from our shores. All practical men with whom I have conversed on the subject, have agreed that the manual training of the artizan or operative should not be postponed beyond the fourteenth year, and that the shop or factory is the only school in

which thorough manual training can be obtained. Book learning is an excellent thing in due season, but so is hand learning, and the one should not be allowed to usurp the place of the other. An infant taken from the cradle and reared in swaddling bands so as to be deprived of all muscular movement, and thus of the stimulus requisite to the development of the motor centres in its cerebrum, would almost infallibly grow up an idiot, and the boy who is reared with his hands bandaged, physically or morally, or who is by any means withheld from ample exercise and varied discipline of these wonderful and willing organs, must grow up, to some extent, feeble and incapable. Depend upon it that much of the confusion of thought, awkwardness, bashfulness, stammerings, stupidity, and irresolution which we encounter in the world, and even in highly educated men and women, is dependent on defective or misdirected muscular training, and that the thoughtful and diligent cultivation of this is conducive to breadth of mind as well as to breadth of shoulders. Depend upon it that there is much virtue, intellectual and moral, in a trade well learned, and that a strong, steady, adroit and obedient right hand is one of man's proudest possessions—as proud a possession as a glib tongue, for there must be a strong, steady, adroit and obedient brain behind to drive it.

The most learned and affluent Jews have always been taught a trade. Spinoza made spectacles, and Mendelssohn spun silk, and I would firmly maintain that every boy, no matter what his social position or prospects may be, should learn some handicraft, and that every girl should be brought up to ply her fingers deftly. In secondary and high schools, shops for manual training are very desirable, and such shops have indeed been provided in some of them, though perhaps they are not utilized as systematically and generally as they might be. Clearness and precision of thought, besides some vulgar use-

fulness, would flow from a brief apprenticeship served in them during the course of the longer apprenticeship to letters, and it would be a preservative to mental health, to studious brain-workers, and harassed business-men all their days, to have an interesting mechanical occupation to which to turn. In central elementary schools, like those in Manchester, Sheffield, and Birmingham, into which are gathered the more promising and advanced pupils from the ordinary elementary schools of the town or city, to be trained as managers, foremen, workmen of a superior class, or for even higher walks in life, and in which the period of elementary education is prolonged, workshops should certainly be established, so that the hand centres may not lie fallow too long. Such manual schools, attached to higher elementary schools, even although they may not shorten the subsequent apprenticeship, still do valuable work; but I question much whether success can attend the attempt to annex such schools to ordinary Board or denominational schools. The fact is that elementary schools, with the Code hanging over them and crippled by the system of payment by results, have already quite enough to do. The withdrawal of scholars for two or three hours a week, for manual instruction, from the obligatory school work, while the requirements of examiners remained the same, could only lead to increased overpressure. The expense and practical difficulty also of providing tools, material, and instruction at a large number of schools must always stand in the way of the multiplication of school workshops. The attempt to provide such workshops in connection with two Board Schools in Manchester has proved a failure, and when I visited these workshops three years ago they were abandoned to dust and dilapidation, containing only some warped benches, impossible lathes, broken tools, and very uncouth specimens of carpentry. The manual training in our elementary schools, and during elementary

education ages, which is, as it has been argued, of such high consequence to the industrial future of the country, which is, by stimulating growth in the hand centres in the brain when they are in their most mobile and ductile and active state, to preserve our national skill, and brace the sinews of the national character, is, I believe, to be most readily and effectually obtained in drawing and modeling. These should be an obligatory part of school work, and should be taught only by those who have a knowledge of them, and have been trained in the art of teaching them. Living as we have done, at any rate in the industrial hives of England, in the midst of much ugliness, and destitute of the art traditions and art treasures of some continental countries, we have hitherto neglected art education, and have been content that drawing should be taught by making shaky copies of hideous lithographs of landscapes and cottages, in which "a decent straight line would," it has been said, "be regarded as a blemish and unpicturesque." But we are awakening to a better sense of the value of drawing as a branch of education, and as the best preliminary education for the hand. We are learning that drawing when taught badly is mischievous and a waste of time, but when taught truly is conducive to accuracy of observation, to reasoning from effect to cause, to habits of neatness, to the love of the beautiful and true, and to that hand-skill which it is of such vital consequence to us to retain. By some mitigation of the demands of inspectors in compulsory and class subjects, and by some re-arrangement of our school curriculum, time must be found for the thorough and methodical teaching of drawing, which in infant schools should occupy one half the school time, and in elementary schools hold a more prominent and honored place than it has heretofore done. Drawing and modeling, it appears to me, offer the true universal training of the hand, the best exercise for the hand centres in the brain, and the most

suitable introduction to the handicrafts which the great bulk of our people must follow for a living. Now that the age at which manual occupations are begun has been raised, and properly raised, in order that elementary education may be secured, drawing and modeling have assumed a new importance as branches of education. The time to begin the training of the hand is in the infant school, and not after passing the sixth standard.

In those admirable technical schools which are springing up in our large towns, to serve as connecting links between the elementary school and the workshop, and in which the foremen, managers, and the most skilled artizans of the future will, in all probability, receive some part of their training, instruction in drawing, and more especially in drawing with rule and compass, will, in conjunction with instruction in the rudiments of science bearing upon industry, take an exalted position. The organization of these schools at present leaves little to be desired, and the work which they are already accomplishing is of conspicuous value; but here, again, we must guard ourselves against expecting too much from them, and against extending unduly the time spent in them, remembering that the workshop is still, and ever must be, the best school for the foreman, and that downright experience is the choicest training for the practical man.

"The training of the shop," said Mr. Reynolds, the founder and able and energetic superintendent of the Technical School at Manchester, in an interview which I had with him a short time ago, "is, and always must be, superior to that of any technical or manual school. It is carried on under a sense of responsibility, and with a consciousness that penalties attach to failure in it, and, above all, it is real and earnest." Mr. Reynolds' remarks recalled to me the old story of the amateur angler who went to fish in a Scotch stream, provided with the finest rod and reel that money could buy, the most invisible tackle, and

the most improved fly-hooks, and who, having flogged the water for hours without getting a nibble, had the mortification of seeing an old fisherman near him pull out the trout by dozens, with nothing but a bit of stick and a string. Puzzled and disappointed, he at last went up to the old man and asked him, "What is the meaning of this? How comes it that I, with the most perfect appliances, catch nothing, while you, with only the clumsiest tools, are so successful?" To which the old man answered: "The meaning o't, Sir, I tak' to be this, that I'm fishin' for fish, and ye're fishin' for fun." The story seems to me to illustrate the difference which must, to some extent, exist between technical school and workshop training, and to explain the greater intensity of purpose and better practical results which must attend the latter.

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